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IN-SPACE TECHNOLOGY EXPERIMENTS

IN-REACH & OUT-REACH PROGRAMS

A
PROGRAM
OVERVIEW
BY
JON S. PYLE

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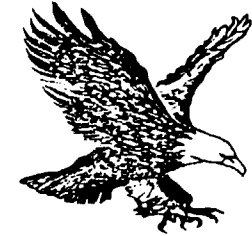
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IN-SPACE TECHNOLOGY EXPERIMENTS



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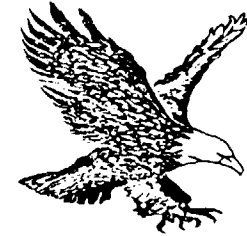
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IN-REACH & OUT-REACH PROGRAMS

- FORMALIZED PROCESS OF IDENTIFYING ADVANCED SPACE TECHNOLOGIES
 - TECHNOLOGIES MUST BE FULLY DEVELOPED ON GROUND
 - REQUIRES SPACE FLIGHT ENVIRONMENT FOR VALIDATION OR VERIFICATION
- PROGRAMS INCLUDE:
 - EXPERIMENT DEFINITION
 - HARDWARE DEVELOPMENT
 - EXPERIMENT INTEGRATION
 - FLIGHT SUPPORT
 - REPORTING

IN-SPACE TECHNOLOGY EXPERIMENTS

OBJECTIVES



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- PROVIDE FOR IN-SPACE FLIGHT RESEARCH
EVALUATION & VALIDATION OF ADVANCED
SPACE TECHNOLOGIES

OUT-REACH PROGRAM

- INDUSTRY/UNIVERSITY FLIGHT
TECHNOLOGY EXPERIMENTS

IN-REACH PROGRAM

- NASA FLIGHT TECHNOLOGY
EXPERIMENTS

IN-REACH

NASA IN-SPACE TECHNOLOGY EXP.



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- **CENTERS REPRESENTED:**

ARC, GSFC, JPL, JSC, LaRC, LeRC, MSFC

- 58 PROPOSALS SUBMITTED

- 7 PROPOSALS SELECTED

- **FLIGHT EXPERIMENT DEFINITION:**

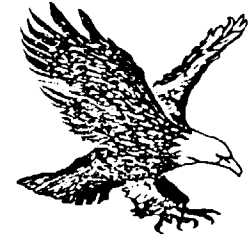
- DEBRIS COLLISION SENSOR
- SPACE STATION STRUCTURAL CHARACTERIZATION
- LASER COMMUNICATION
- LASER SENSOR
- CONTAMINATION SENSOR
- EXPOSURE OF THIN-FOIL MIRRORS

- **FLIGHT EXPERIMENT DEVELOPMENT**

- THERMAL ENERGY STORAGE MATERIALS
TECHNOLOGY

IN-REACH

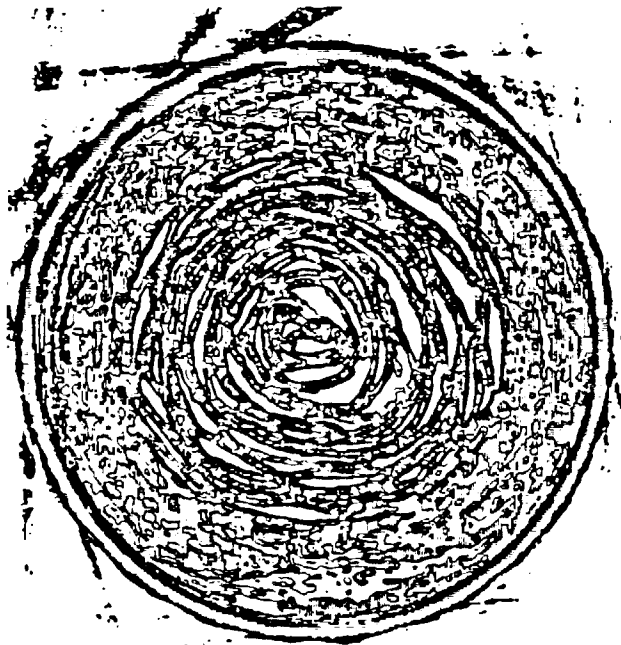
FLIGHT EXPERIMENT DEVELOPMENT



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THERMAL ENERGY STORAGE (TES) MATERIALS TECHNOLOGY



CONCEPT:

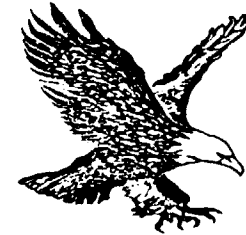
- IN-SPACE THERMAL CYCLING OF A VARIETY OF PHASE CHANGE TES MATERIALS (VARING TEMPERATURE RANGES) TO UNDERSTAND VOID CHARACTERIZATION IN MICRO-G

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COMPUTER ENHANCED SCAN OF
TES CANISTER CROSS-SECTION

IN-REACH

FLIGHT EXPERIMENT DEVELOPMENT



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THERMAL ENERGY STORAGE (TES) MATERIALS TECHNOLOGY

OBJECTIVES:

- IDENTIFY VOID LOCATION, VOID SIZE & MELT/FREEZE PATTERNS FOR VARIOUS TEMPERATURE RANGE TES MATERIALS UNDER MICRO-GRAVITY CONDITIONS
- VERIFY ANALYTICAL & GROUND EXPERIMENTAL PREDICTED BEHAVIOR OF TES MATERIALS SUBJECTED TO THE MICRO-GRAVITY ENVIRONMENT

BENEFITS/PAYOFFS:

- CRITICAL TO DESIGN OF ADVANCED, LONGER LIFE, HIGHLY RELIABLE INTEGRAL THERMAL STORAGE HEAT RECEIVERS
- SIGNIFICANT REDUCTION IN WEIGHT POSSIBLE OVER PHOTOVOLTAIC SYSTEM

LEAD CENTER CONTACT:

- DR. LYNN ANDERSON
LEWIS RESEARCH CENTER
(216) 433-2874

OUT-REACH

INDUSTRY/UNIVERSITY IN-SPACE

TECHNOLOGY EXPERIMENTS



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- PARTICIPATION:

- 231 PROPOSALS SUBMITTED (91 UNIVERSITY & 140 INDUSTRY)

- 36 FLIGHT EXPERIMENT DEFINITION STUDIES:

- 5 SPACE STRUCTURES
- 7 FLUID MANAGEMENT
- 3 INFORMATION SYSTEMS
- 5 ENERGY SYSTEMS & THERMAL MANAGEMENT
- 2 SPACE ENVIRONMENTAL EFFECTS
- 10 IN-SPACE OPERATIONS
- 4 AUTOMATION & ROBOTICS

- 5 FLIGHT EXPERIMENT HARDWARE DEVELOPMENTS:

- HEAT PIPE THERMAL PERFORMANCE & FLUID BEHAVIOR
- TANK PRESSURE CONTROL
- INVESTIGATION OF SPACECRAFT GLOW
- MID-DECK ZERO-GRAVITY DYNAMICS EXPERIMENT
- EMULSION CHAMBER TECHNOLOGY

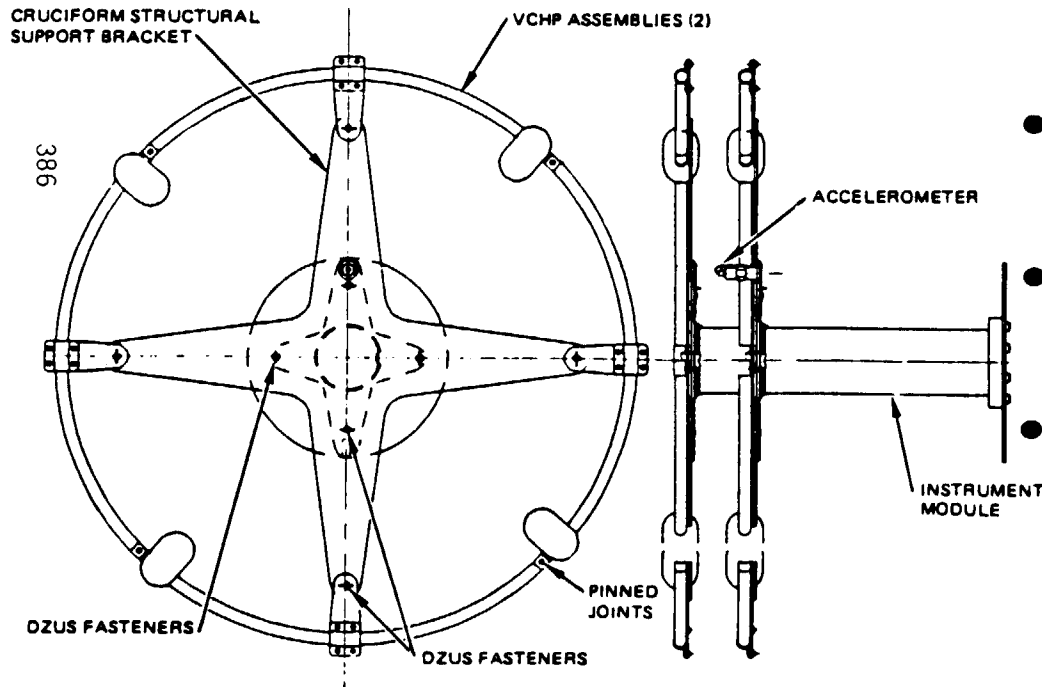
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HEAT PIPE PERFORMANCE & WORKING FLUID BEHAVIOR



CONCEPT:

- SPACE SHUTTLE MID-DECK LOCKER OR COMPLEX SELF-CONTAINED PAYLOAD
- TWO SETS OF HEAT PIPES (4 EACH) MOUNTED ON A CRUCIFORM STRUCTURE
- ARTIFICIAL ACCELERATION LEVELS (VARIABLE G) APPLIED TO HEAT PIPES BY CONTROLLED SPINNING

OUT-REACH

FLIGHT EXPERIMENT DEVELOPMENT



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HEAT PIPE PERFORMANCE & WORKING FLUID BEHAVIOR

OBJECTIVES:

- STUDY EFFECTS OF MICRO-GRAVITY ON WORKING FLUIDS IN HEAT PIPES
- DETERMINE RECOVERY RATES FOR DEPRIMED VARIABLE CONDUCTANCE HEAT PIPES IN 0-G
- VALIDATE ANALYTICAL MODELS & UPGRADE GROUND TEST TECHNIQUES

BENEFITS/PAYOFFS:

- SPACECRAFT LIQUID INVENTORIES COULD BE REDUCED THROUGH BETTER UNDERSTANDING OF 0-G FLUID BEHAVIOR
- IMPROVE POWER SYSTEM HEAT DISSIPATION & REDUCE ADVANCED SPACECRAFT SYSTEM DESIGN RISKS

LEAD CENTER CONTACT:

- DON FRIEDMAN
GODDARD SPACE FLIGHT CENTER
(301) 286-6242

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FLIGHT EXPERIMENT DEVELOPMENT

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FLIGHT PROJECTS

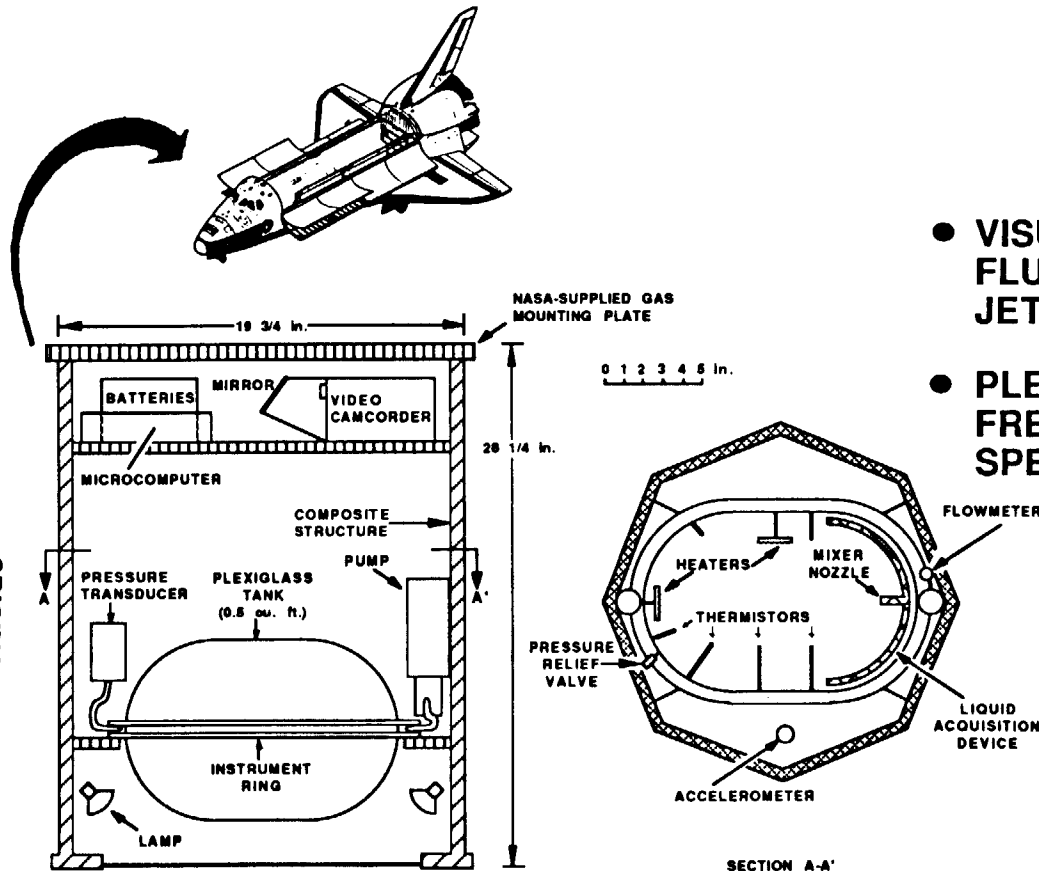
TANK PRESSURE CONTROL EXPERIMENT

CONCEPT:

- VISUAL & THERMAL EVALUATION OF FLUID MIXING BY MEANS OF A JET INDUCED FLOW
- PLEXIGAS CANNISTER USING LIQUID FREON MOUNTED IN A GET AWAY SPECIAL (GAS) PAYLOAD (MANIFESTED 7/90)

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OUT-REACH

FLIGHT EXPERIMENT DEVELOPMENT



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TANK PRESSURE CONTROL EXPERIMENT

OBJECTIVES:

- DETERMINE THERMAL STRATIFICATION OF FLUIDS IN 0-G
- STUDY EFFECTIVENESS OF JET INDUCED MIXING
- VALIDATE OR UPGRADE EXISTING ANALYTICAL MODELS

BENEFITS/PAYOFFS:

- REDUCES TANK OVERPRESSURE RISKS CAUSED BY HIGH THERMAL GRADIENTS IN LIQUIDS
- PROVIDES BETTER DESIGN TECHNIQUES FOR FUTURE SPACECRAFT SYSTEMS

LEAD CENTER CONTACT:

- DR. LYNN ANDERSON
LEWIS RESEARCH CENTER
(216) 433-2874

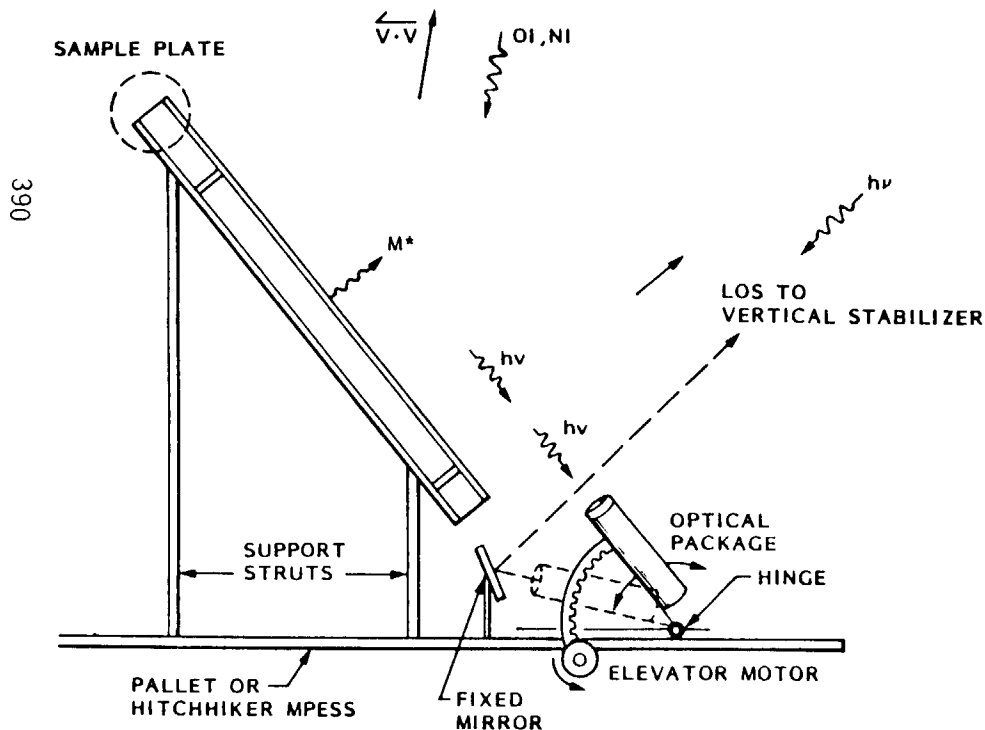
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FLIGHT EXPERIMENT DEVELOPMENT

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INVESTIGATION OF SPACECRAFT GLOW

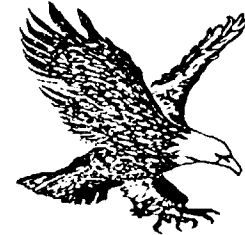


CONCEPT:

- PLATE WITH MATERIAL SAMPLES MOUNTED TOWARD RAM (NORMAL INCIDENCE) DIRECTION
- OPTICAL MEASUREMENTS USED TO CHARACTERIZE THE GLOW
- OBTAIN MEASUREMENTS OF GLOW ABOVE MATERIAL SURFACE OVER TEMPERATURE RANGE & SPECTRAL REGIONS

OUT-REACH

FLIGHT EXPERIMENT DEVELOPMENT



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INVESTIGATION OF SPACECRAFT GLOW

OBJECTIVES:

- MEASURE THE INTENSITY, SPATIAL DISTRIBUTION & SPECTRUM OF SPACE GLOW
- DETERMINE THE GLOW INTENSITY AS A FUNCTION OF SURFACE TEMPERATURE & MATERIALS
- IDENTIFY MECHANISMS PRODUCING GLOW & APPROACHES TO MINIMIZE ITS EFFECTS

BENEFITS/PAYOFFS:

- ELIMINATE INTERFERENCE OF GLOW ON SPACE FLIGHT EXPERIMENTS (SUCH AS OPTICS)
- MAY PROVIDE TECHNIQUES FOR SPACECRAFT DETECTION & IDENTIFICATION

LEAD CENTER CONTACT:

- KEITH HENDERSON
JOHNSON SPACE CENTER
(713) 282-1807

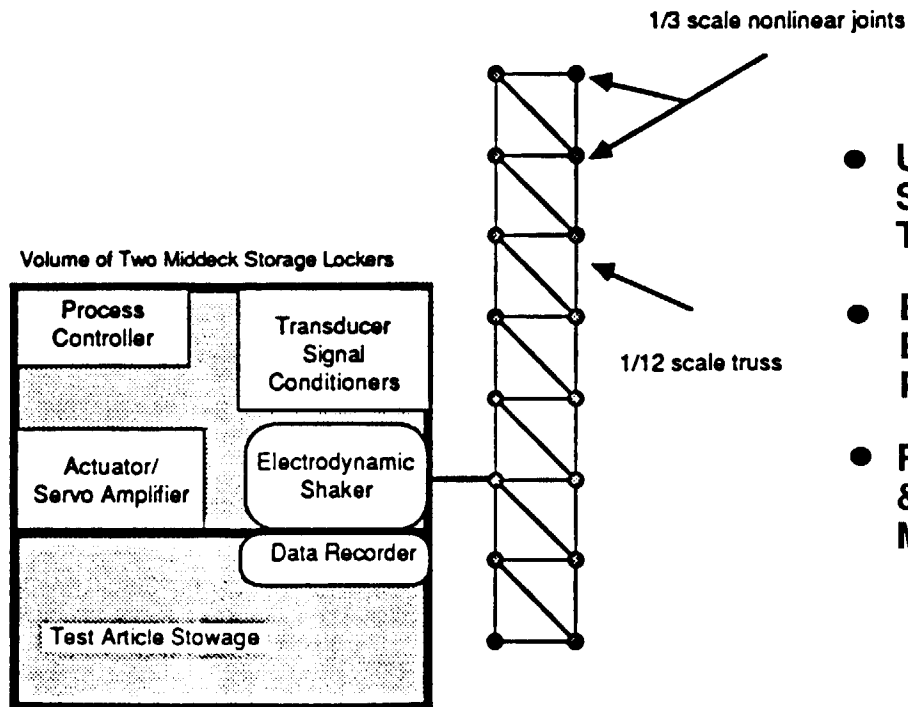
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MID-DECK ZERO-GRAVITY DYNAMICS EXPERIMENT



CONCEPT:

- USES SKEWED-SCALE ERECTABLE STRUCTURE WITH SPACE STATION TYPE JOINTS
- ELECTRONICALLY CONTROLLED EXCITER DYNAMICS TO PROVIDE PREDICTABLE INTERACTION
- REUSABLE EXCITER/CONTROLLER & DATA RETREIVAL SYSTEM IN MID-DECK LOCKERS

OUT-REACH

FLIGHT EXPERIMENT DEVELOPMENT



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MID-DECK ZERO-GRAVITY DYNAMICS EXPERIMENT

OBJECTIVES:

- INVESTIGATE DYNAMICS OF NONLINEAR SPACECRAFT SYSTEMS IN A MICRO-GRAVITY ENVIRONMENT
- PROVIDE LONG DURATION 0-G FLIGHT DATA TO CORRELATE WITH GROUND TEST RESULTS & ANALYTICAL PREDICTIONS

BENEFITS/PAYOFFS:

- REDUCE RISKS OF SPACECRAFT DESTABILIZATION DUE TO LIMITED UNDERSTANDING OF COMPLEX DYNAMIC INTERACTIONS
- IMPROVED DESIGN TECHNIQUES & GREATER RELIABILITY ALLOW REDUCTIONS IN SPACECRAFT WEIGHTS

LEAD CENTER CONTACT:

- LENWOOD CLARK
LANGLEY RESEARCH CENTER
(804) 865-4834

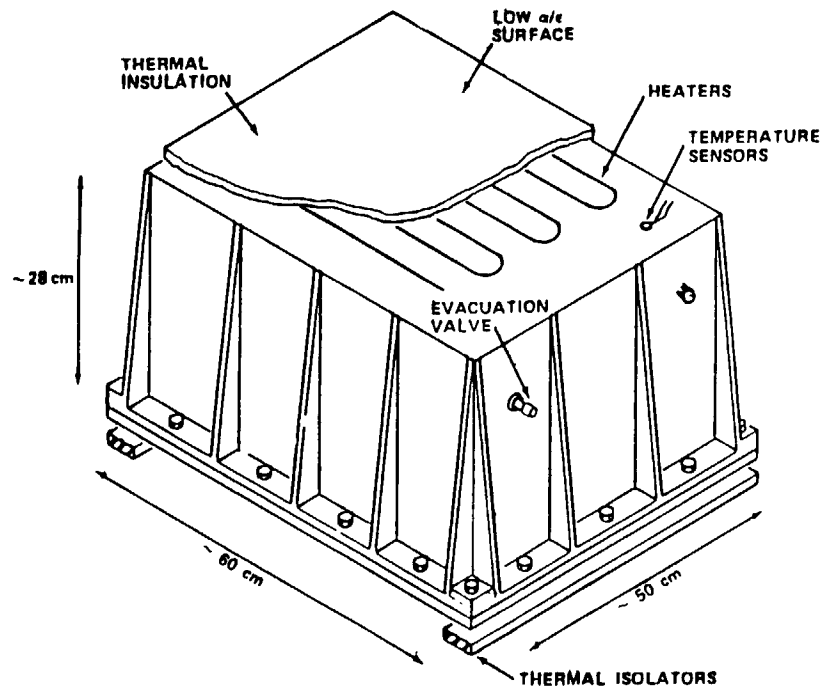
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EMULSION CHAMBER TECHNOLOGY



CONCEPT:

- 300 LAYER NUCLEAR TRACK EMULSION IN SHIELDED HERMETIC ENCLOSURE
- LONG TERM EXPOSURE TO SPACE ENVIRONMENT IN SPACE SHUTTLE BAY

OUT-REACH

FLIGHT EXPERIMENT DEVELOPMENT



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EMULSION CHAMBER TECHNOLOGY

OBJECTIVES:

- VALIDATION OF EMULSION CALORIMETER TO BE USED FOR HIGH ENERGY COSMIC RAY DETECTION
- STUDY OF SHIELDING TECHNIQUES FOR EMULSION CALORIMETERS
- VERIFY PREDICTED HIGH ENERGY PARTICLE DATA

BENEFITS/PAYOFFS:

- ENABLES EXTENSION OF COSMIC RAY COMPOSITION & NUCLEAR INTERACTION CHARACTERISTICS
- POTENTIAL IMPROVEMENTS IN SHIELDING APPLICATIONS FOR FUTURE MANNED SPACECRAFT

LEAD CENTER CONTACT:

- JON HAUSSLER
MARSHALL SPACE FLIGHT CENTER
(205) 544-1762

IN-REACH & OUT-REACH PROGRAMS



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IN-SPACE TECHNOLOGY EXPERIMENTS

WORKSHOP

HYATT REGENCY HOTEL
ATLANTA, GA

DECEMBER 6, 7, 8, & 9, 1988



IN-REACH & OUT-REACH PROGRAMS

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IN-SPACE TECHNOLOGY EXPERIMENTS WORKSHOP

WORKSHOP PURPOSE

- REVIEW OF CURRENT PROGRAMS & DISCUSSION OF FUTURE PLANS
- DESCRIPTION OF FLIGHT OPPORTUNITIES & INTEGRATION PROCESS
- IDENTIFICATION OF CRITICAL TECHNOLOGY NEEDS IN EACH THEME AREA

